



## Naval Research Laboratory - Office of Naval Research Materials Science and Technology

<http://mstd.nrl.navy.mil>

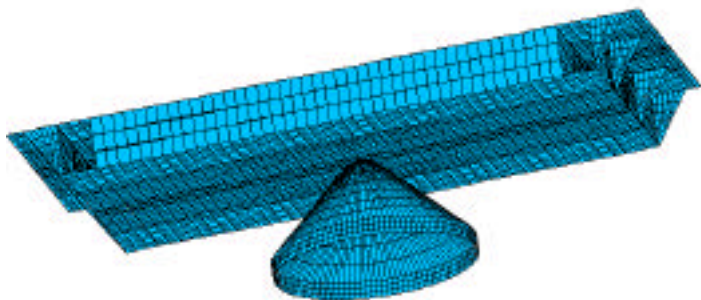
### *Science and Technology Success Stories*

## Component Response and Microstructural Analysis

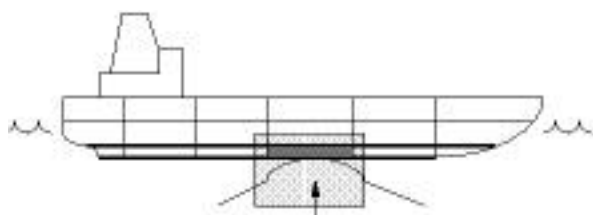
The Naval Research Laboratory (NRL), the Navy's corporate laboratory, has the capability to model and simulate complex structural and microstructural performance of materials. Analyses have included large strain elastic-plastic deformations, contact and local fracture in both shell and continuum models. These models have investigated the mechanisms that lead to structural failure. Computational results are correlated with experimental tests to validate methodologies.

Examples of analyses conducted at NRL include simulations of longitudinally stiffened double hull test sections to evaluate inner hull rupture during a stranding event. This analysis demonstrated sufficient hull strength and ductility to withstand and avoid inner hull rupture.

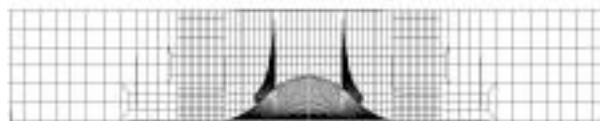
An example of microstructural response has been the modeling of a porous core structure of low density core Ti-6-Al-4V sandwich panel. This investigation determined material and geometric factors affecting fracture initiation and propagation through the sandwich panel.



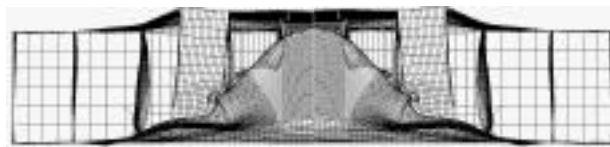
Quarter scale advanced double hull stranding analysis model



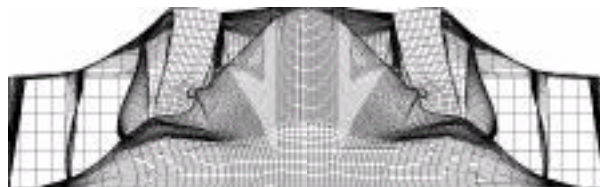
Schematic of stranding incident



7.15" Outer hull penetration



19.2" Outer hull penetration



30.0" Outer hull penetration

# Component Response and Microstructural Analysis

## Military Impact

- Improved predictive capability for:
  - Structural response of naval vessels during stranding incidents
  - Damage tolerance of structure/material
  - Modeling of microstructure to produce lightweight components for naval aircraft

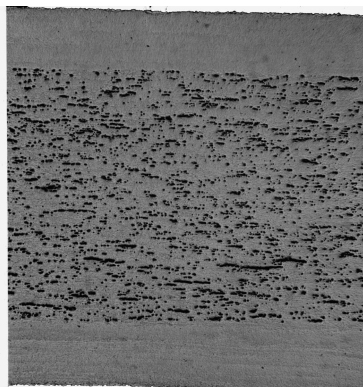
## Potential Civilian Spin-offs

- Simulation capabilities for:
  - Improving commercial oil tanker design
  - Development of lightweight commercial aircraft parts

## Point of Contact

Dr. Peter Matic                      202-767-5215  
Code 6352, Naval Research Laboratory  
Washington D.C. 20375-5343

## Microstructural Modeling of Low Density Core Panel

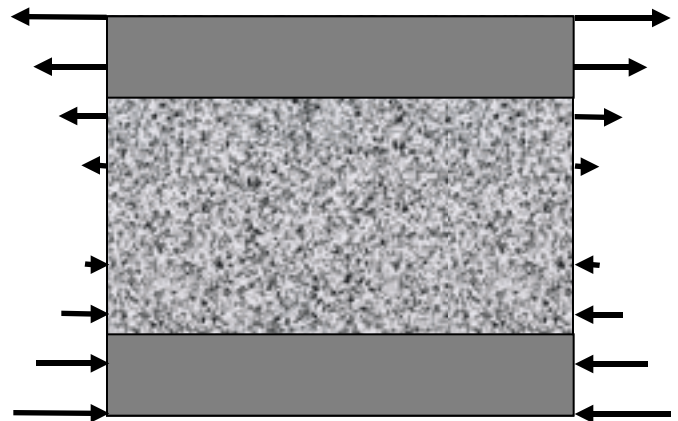


← Solid face sheet

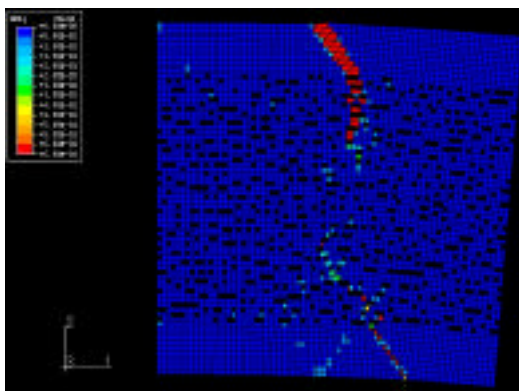
← Porous core

← Solid face sheet

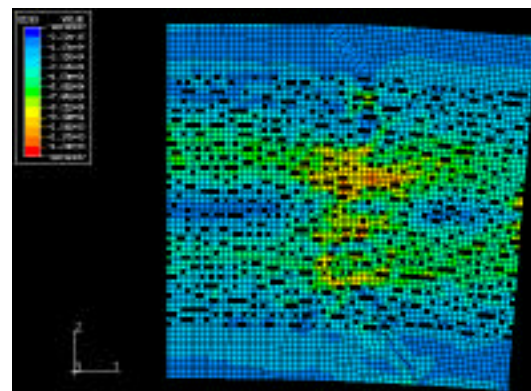
Micrograph of the low density core sandwich structure



Schematic of applied bending



(a)



(b)

Finite element model under applied bending - (a) Plastic strain and fracture paths (in red) that lead to panel failure (b) Model unloading and stress localization as fracture propagates from interior to top surface of panel